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# FEASIBILITY STUDY OF PIEZO TRANSISTOR ACCELEROMETER

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The object of this contract is to study the feasibility of using semiconductor junctions as the sensing elements for accelerometers.

This work is progressing on schedule. During this reporting period, major emphasis has been on experimentation designed to exhibit the many facets of the piezojunction phenomenon in both single and multiple p-n junction devices and to varify the theoretical model as developed for the effect. The data obtained from these experiments are being analyzed with the aim of obtaining design information for use in transducers for accelerometers.

During the reporting period a method was developed for recording current-voltage characteristics of p-n junctions directly on an x-y recorder. Data acquisition was greatly enhanced with the automated setup. This method was used to compile data on mesa diodes, planar diodes, and transistors under stress.

Mesa and planar diodes under stress were exposed to environmental temperatures ranging from $-20^{\circ}C$ to $+70^{\circ}C$ in an effort to determine the effect of temperature on stress sensitivity. As was expected, these tests indicated that stress sensitivity is temperature dependent.

Tests were conducted to determine long term stability of p-n junctions. Mesa and planar diodes were placed in a constant stress environment for long periods of time. This test had no appreciable effect on the junction characteristics.

Four-layer junction devices were also tested during this period. The devices were individually connected into an oscillator circuit, the frequency of which was dependent on the parameters of the junction device. As predicted stress applied to the device had the effect of increasing the oscillation frequency. This type of force sensing element is very promising for accelerometers and other transducers.

The method of applying stress to p-n junctions is a major problem in the design of a laboratory piezojunction accelerometer. Steel or diamond phonograph needles can be used to apply this stress, but a critical alignment problem is involved. Since large stress levels are required to change p-n junction characteristics, it is imperative that the junction area be very small so that the force required to produce this stress is reasonable. For this reason, the alignment of the needle and junction is a difficult process which must be performed under a microscope.

Since placing a needle on a junction presents a problem, the possibility of placing a junction on the apex of a silicon needle was investigated. Stress could then be applied by forcing the needle onto a smooth surface.

A procedure using electroetching techniques was developed for producing silicon needles. p-n junctions have been successfully diffused onto the apex of these needles, and attempts made to incorporate them into a working laboratory accelerometer. The problem of making electrical contact between the needle-diode and the surface onto which it is forced has been a limiting factor to the success of these efforts.

The forthcoming quarter will be devoted to further testing of junction devices and to the development and testing of a laboratory accelerometer capable of demonstrating the piezojunction phenomenon. The needle-diodes described above will be used as the basic transducer element.